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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C08L 25/06, 69/00, 33/12, 55/02, 25/12, 67/02, 67/00 — A1

(11) International Publication Number: WO 99/50347

(43) International Publication Date: 7 October 1999 (07.10.99)

(21) International Application Number: PCT/GB99/00946

(22) International Filing Date: 25 March 1999 (25.03.99)

(30) Priority Data:
9806631.9 28 March 1998 (28.03.98) GB

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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SAFETY GLASS

(57) Abstract

Material for use as safety glass comprises a mixture of polymeric material and a thermoplastic polystyrene resin having a molecular weight of between 500 and 5000. The polymeric material is selected from high molecular weight impact or crystal polystyrene, polycarbonate, acrylic polymers, ABS, SAN and polyester. The material may further comprise ingredients selected from the list of UV inhibitors, antioxidants, flow modifiers, fire retarding agents, colour pigments and brighteners. The material is typically used in emergency equipment, glassware and windows.

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SAFETY GLASS

The present invention relates to a type of safety glass, particularly safety glass that can be used in storage containers for emergency equipment.

At present there are several emergency devices where glass is used. The glass is used for its transparency and breakable properties, so that the person using the emergency device, such as a fire-axe, can not only observe the presence of the safety article in its retaining box but can also easily break the glass to access the device when required. Glass finds similar applications in emergency door releases, fire alarm activators and many other emergency devices.

The problem with the use of glass in such applications is that the glass must be broken to access the device to be used. Often there is a subsidiary device that can be used to break the glass. However, this may be missing or not be supplied as part of the device. In either case the breakage of the glass will cause the previously harmless sheet of glass to be broken into sharp glass fragments and also glass splinters.

Needless to say the presence of sharp glass poses an unnecessary hazard to the user, particularly if the sharp glass injures the user in an attempt to access a safety device.

The use of glass may often present other problems to the potential user of a safety device, for example that person may assume that the glass used is safety glass and be surprised at any damage that they inflict upon themselves and any others. The potential user may also question as to whether they can access the device without causing any damage to themselves, any such time wasted in the case of an emergency could be crucial and should be avoided.

It is also possible that malicious or accidental damage may occur and the layer of glass in the retaining device may be broken in a non-emergency situation. In any case there may be sharp fragments of glass left behind, which can be a danger to passers by.

Also some organisations now insist upon either a strict control of glass usage within their buildings or the complete prohibition of the use of glass. Some areas of hospitals and food preparation are now insistent on being glass free zones.

There has already been considerable research carried out on products that can be used to replace glass. One such product is perspex, which like glass is transparent and being a polymeric material should not produce the same shards as are produced by breaking glass.

However, the use of perspex and its related plastics is not without its problems. Perspex can be harder to break than glass as it is not as fragile and can still produce sharp fragments that can injure the user in the same way as glass can.

It is an object of the present invention to provide an improved material for use as safety glass.

According to the present invention there is provided a material having a tensile stress limit of between 11 and 60 Nmm^{-2}, that is or can be made transparent and can be made into sheets/structures just like ordinary glass, but that shatters when broken into fragments that are not capable of damaging human skin or tissue and which is comprised of a mixture of polymeric material and/or a thermoplastic polystyrene resin and/or a thermoplastic vinylaromatic resin.

Preferably the polymeric material is chosen from the group consisting of crystal or impact polystyrene, polycarbonate, acrylic, ABS (acrylonitrile butadiene styrene), SAN (styrene and acrylic blend) and polyester.

Preferably the thermoplastic polystyrene resin is chosen from the group consisting of co-polymers of styrene and alpha methyl styrene, hydrogenated aliphatic polymer and styrene monomer.

Preferably also the thermoplastic polystyrene resin has a molecular mass of between 500 and 5000.

Preferably also the safety glass of the present invention includes other ingredients selected from the list of UV

inhibitors, antioxidants, flow modifiers, fire retarding agents, colour pigments and brighteners.

Preferably these ingredients are present in the safety glass of the present invention at between 0.001% and 0.01%.

Preferably the safety glass of the present invention can be etched upon.

In a preferred embodiment of the invention the safety glass of the present invention is composed of crystal or impact polystyrene (0-85%) and thermoplastic polystyrene resin (0-15%) together with 0.001% to 0.01% UV inhibitors, antioxidants, flow modifiers, fire retarding agents, colour pigments and brighteners, which gives a safety glass material which has a stress limit of between 11 and 60 Nmm^{-2}.

The preferred embodiment of the invention can be used in such applications as emergency equipment enclosures (key boxes, first aid boxes, fire extinguisher enclosures, window hammer enclosures, access panels, door egresses housing manually operated door handles), break glass fire alarms and emergency kick out panels.

The preferred embodiment of the invention can also be used in other applications such as drinking glasses, bottles and non-emergency windows, preventing injuries from conventional glass in these applications.

The mechanism which makes safeglass break, and break into safe parts is the low molecular weight of the material. Low molecular weight in polymers is a function of the

length of the chains. In this case the polystyrene resin has a very low molecular weight, too low in fact to be of any use, and also difficult to mould. By mixing low molecular weight polystyrene resin in the molecular mass range 500-5000 to crystal or high impact polystyrene it has the effect of lowering the stress limit of the latter. The resulting material is suitable for the present invention and processing it is greatly improved. The same theory applies to any other clear plastic, such as PMMA (acrylic) for example. By mixing low molecular weight acrylic to high molecular weight acrylic a new material could be produced. In this case we would be looking to produce a material with a molecular weight of approximately 3000 for it to be of any use.

Two important applications:

1. GLASSWARE AND BOTTLES: 12000 drink related incidents happen every week. The Home Office are to order magistrates to tighten conditions of pub and club licences to use toughened glasses to serve beer. This will reduce the injuries caused when glasses are used as weapons, currently running at 5500 per year. Safeglass glasses and bottles could play an important safety and security role in clubs or live events, they would also be cheaper than glass.

2. WINDOWS: Windows set in interior doors have to be made of toughened glass if they are fitted below a certain height, this is to save small children or fall victims from injury. However it is very expensive and still produces tiny cubes of sharp glass. Safeglass is safer and less expensive.

The safety glass of the present invention will now be described with reference to the following examples.

Example 1

The safety glass of the preferred embodiment of the invention is composed of crystal or impact polystyrene and an intermediate weight polystyrene resin (of molecular mass 500 to 5000). This material can be manufactured with a stress limit of between 11 to 60 Nmm^{-2}.

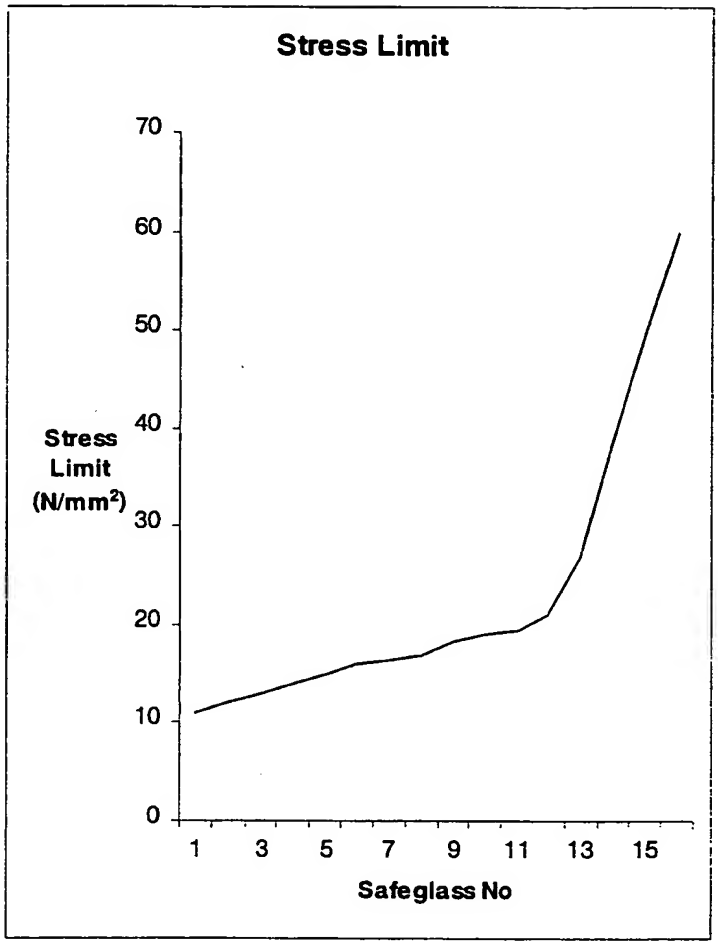
The following table shows the variation of the stress limit value of the preferred embodiment of the safety glass of the present invention.

Table 1

SAFEGLASS NO.	% CRYSTAL/IMPACT POLYSTYRENE	% POLYSTYRENE RESIN	STRESS LIMIT
1	0	100	11
2	5	95	12
3	10	90	13
4	15	85	14
5	20	80	15
6	25	75	16
7	30	70	16.4
8	35	65	17
9	40	60	18.4
10	45	55	19
11	50	50	19.5
12	55	45	21
13	60	40	27
14	75	25	39
15	80	20	50
16	85	15	60

This information is also represented graphically in Figure 1.

Figure 1



To determine which safety glass composition is to be used in a particular application a stress calculation must be carried out using the following formula.

Formula 1

$$S = \frac{3 F L}{2 b h^2}$$

where S is the stress limit in N/mm^2
F is the force in Newtons
L is the length of the panel in metres
b is the width of the panel in metres
h is the depth of the panel in metres

Example 2

As Example 1 with the inclusion of the thermoplastic resin obtained by polymerisation of various vinylaromatic monomers.

Example 3

As Example 2 except that the crystal/impact polystyrene is replaced by polycarbonate.

Example 4

As Example 2 except that the crystal/impact polystyrene is replaced by acrylonitrile.

Example 5

As Example 2 except that the crystal/impact polystyrene is replaced by ABS (acrylonitrile butadiene styrene).

Example 6

As Example 2 except that the crystal/impact polystyrene is replaced by SAN (styrene and acrylic blend).

Example 7

As Example 2 except that the crystal/impact polystyrene is replaced by polyester.

Further modifications and improvements may be added without departing from the scope of the invention herein intended.

Claims:

1. A material having a tensile stress limit of between 11 and 60 Nmm^{-2}, that is or can be made transparent and can be made into sheets/structures just like ordinary glass, but that shatters when broken into fragments that are not capable of damaging human skin or tissue and which is comprised of a mixture of polymeric material and/or a thermoplastic polystyrene resin and/or a thermoplastic vinylaromatic resin.

2. A material as claimed in Claim 1 wherein the polymeric material is chosen from the group consisting of crystal or impact polystyrene, polycarbonate, acrylic, ABS (acrylonitrile butadiene styrene), SAN (styrene and acrylic blend) and polyester.

3. A material as claimed in Claim 1 or 2 wherein the thermoplastic polystyrene resin is chosen from the group consisting of co-polymers of styrene and alpha methyl styrene, hydrogenated aliphatic polymer and styrene monomer.

4. A material as claimed in Claim 3 the thermoplastic polystyrene resin has a molecular mass of between 500 and 5000.

5. A material as claimed in any one of the preceding Claims wherein said material further includes ingredients selected from the list of UV inhibitors, antioxidants, flow modifiers, fire retarding agents, colour pigments and brighteners.

6. A material as claimed in Claim 5 wherein the ingredients are present at between 0.001% and 0.01%.

7. A material as claimed in any one of the preceding Claims wherein said material may be etched upon.

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/GB 99/00946

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C08L25/06 C08L69/00 C08L33/12 C08L55/02 C08L25/12
C08L67/02 C08L67/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ABETZ V ET AL: "THE GLASS TRANSITION OF MIXTURES OF POLYSTYRENE WITH ALKYL -TERMINATED OLIGOSTYRENE - EXPERIMENTAL EVIDENCE FOR MICROPHASE SEPARATION IN A POLYMER BLENS" MACROMOLECULAR CHEMISTRY AND PHYSICS, vol. 196, no. 11, 1 November 1995 (1995-11-01), pages 3845-3857, XP000583913 ISSN: 1022-1352 page 3847, Tab. 1, "Blend preparation" ---	1-4,7
X	WO 97 15868 A (MINNESOTA MINING & MFG) 1 May 1997 (1997-05-01) page 7, line 12-24 page 18, line 10-24 ---	1,2

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
- 10 August 1999	19/08/1999

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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